EXECUTIVE SUMMARY

Background

Health risks from ambient air pollution exposure have emerged as a major public health issue. In this report, we estimate mortality and hospital admissions associated with ambient air pollution exposure in Hamilton. Currently, Hamilton exceeds government objectives by about 20 days per year and has some of the highest ambient air pollution in Canada. Ambient pollution exposures result from a combination of pollution from outside the region, industrial emissions, transportation sources, and local meteorology and topography. All of these factors elevate ambient air pollution exposures and make the issue of health effects particularly important in Hamilton.

Numerous epidemiological studies have found a significant association between air pollution and health effects. In 1997, Pengelly and colleagues estimated that air pollution was associated annually with a midpoint estimate of 214 non-traumatic mortalities in Hamilton. Since 1997, much has been learned about the short-term and chronic health effects of air pollution. The past six years have also seen changing ambient air pollutant levels throughout Hamilton. The combination of new research findings and changing pollution levels has created a need to update and expand on earlier work. Information from this new assessment can help local decision-makers understand the magnitude of health effects from air pollution and in taking action that protects and improves population health in Hamilton.

Methods

To estimate mortality and hospital admissions associated with ambient air pollution in Hamilton, we derived dose-response relationships based on local estimates published in the scientific literature. These estimates were applied to recent data on air pollution and health outcomes available through government sources.

Many of the acute studies pooled here used generalized additive models in their statistical analysis. A recent statistical discovery revealed a programming limitation in the statistical software used, leaving the findings from these studies in question. Reanalyses of data indicate that risk estimates may have been overestimated by as much as 42%. Adjustments were applied to study data to account for the 42% overestimation.

In accordance with past studies, health effect estimates are compared to a zero pollution level, considered by many to be practically unattainable. We thus calculated estimates using a baseline of the lowest quintile of measured pollution values. Local estimates derived from Hamilton-specific models were also conducted. Additional sensitivity analyses were based on pooled random effects models and from chronic studies from other jurisdictions.

We compared these results to earlier studies to assess how estimates of health effects have changed since the last assessment.

Results

Our results revealed a wide range in estimates of mortality and morbidity attributable to air pollution. Using the 1997 study as baseline, estimates conducted using similar methods as the initial HAQI report, resulted in an increase of 76 deaths (298 to 374), due to larger dose-response relationships in the literature and slightly higher ambient pollution levels (Table 1). Respiratory admissions increased by 463 (144 to 607), while cardiovascular admissions increased by 1743 (257 to 2000). The 42% adjustment estimated 217 deaths, 352 respiratory admissions and 1120 cardiovascular admissions. The most conservative estimate involved combining both the 42% adjustment and the 20% baseline models. Using this new methodology, mortality and morbidity estimates decreased to 96 deaths, 139 respiratory and 479 cardiovascular admissions - an average decrease of 76% from our initial estimates.

Table 1. Summary of Mortality and Morbidity Counts Using Average Dose-Response Calculations, Based on 1997 Hamilton Pollution Values.

Pollutant	NT mortality (average incidences/year) average of estimates					Respiratory admissions (incidences/year) average of estimates					CV admissions (incidences/year) average of estimates				
	P1997	CAH	Adj	M-min	M-min adj	P1997	CAH	Adj	M-min	M-min adj	P1997	CAH	Adj	M-Min	M-Min adj
PM_{10}	97	73	43	24	14	48	144	83	46	27	112	280	157	84	49
SO_2	16	53	31	27	16	28	69	40	35	20		56	31	45	26
NO_2	81	134	78	46	27	20	244	142	83	48	125	888	497	303	176
CO	3	10	6	6	3						20	118	66	65	38
O_3	102	105	61	62	36	48	150	87	75	44		659	369	329	191
Total	298	374	217	119	96	144	607	352	239	139	257	2000	1120	826	479

P1997 = HAQI report, Pengelly 1997
CAH = Current reanalysis for City of Hamilton
Adj = Adjusted value of CAH, for overestimate of 42%
M-min = Estimate calculated for pollution values of mean – min (lower quintile) for 1997
M-min adj = Application of adjusted value to M-min calculation

Interpretation

A cautionary note is required with respect to the totals given above. They should be interpreted as general aids to decision-making rather than as exact counts of death and illness. The totals may be influenced by uncontrolled confounding of co-pollutants. This may have resulted in an overestimate of mortality and hospital admission totals.

We have excluded other serious health effects. These include the development and exacerbation of asthma, reproductive abnormalities, elevated cancer rates, and less serious respiratory conditions such as infectious respiratory diseases. Thus, our mortality and admission estimates may, in fact, underestimate the total burden of illness associated with air pollution in Hamilton.

Conclusions

In this report, we have identified air pollution as a major source of mortality and hospital admissions in Hamilton. We have not linked the health estimates to specific sources, but this represents an important area for future research. It appears that gaseous pollutants most closely associated with transportation emissions have increased over the five-year study period (1995-99). The scientific evidence on the health effects of these pollutants has also advanced. The combination of increasing pollution and growing scientific knowledge leads to the conclusion that these sources should be the focus of concerted policy efforts in the realm of land use and transportation planning. Both these areas fall within the jurisdiction of the city. Future research combining the methods used in this report with source apportionment could supply more definitive guidance for priority setting in local decision-making.